Transit Planning Board
WORKING TOGETHER – CONNECTING OUR REGION

Agenda Attachment # 1 to Agenda Item # V.2.

TO: Cheryl King

FROM: John Crocker

DATE: May 22, 2008

SUBJECT: Safety Analysis Metholodogy

This document is intended to describe the methodology proposed to analyze the potential safety impacts of regional transit, and specifically Concept 3, on the Atlanta region. This document only presents the methodology used to analyze the safety impacts, the full results incorporating this methodology will be presented in a report on the impact of Concept 3 to be delivered in June to the Transit Planning Board.

Background

The Transit Planning Board is currently seeking input on a vision for regional transit being called Concept 3. The Board itself has asked for some analysis on the impact of regional transit for the Atlanta region and one area of significant interest is in the area of safety impact – specifically the anticipated impact on crashes and/or fatalities and injuries. As part of the process for evaluating *Envision6*, the currently adopted Regional Transportation Plan for the Atlanta region, the Atlanta regional commission identified a metholody for detemining the impact of transit projects on roadway congestion.[1] The rationale for examining safety impacts of a regional transit system is that there are significant differences in fatality and injury rates between modes. Table 1 below provides and overview of the different injury and fatality rates for different modes.

Mode	Crashes/ 100 million Passenger Miles[2]	Fatalities / 100 million Passenger Miles[3, 4]	Injuries / 100 million Passenger Miles [4, 5]
Private Vehicle	289.8	1.5	91
Bus	48.2	0.5	66
Heavy Rail	0.5	0.22	5
Light Rail	39.0	0.96	27
Commuter Rail	0.9	0.45	14

Table 1 – Crash, Fatality and Injury Rates by mode per 100,000,000 passenger miles

[1] Envision6, "Appendix G: *Envision6* Project Prioritization Technical Analysis" (Atlanta Regional Commission, Atlanta, GA 2008). Pg. G-22 – G25.

[2] Envision6, "Appendix G: *Envision6* Project Prioritization Technical Analysis" (Atlanta Regional Commission, Atlanta, GA 2008). Pg. G-24.

[3] Transit Safety & Security Statistics & Analysis 2003 Annual Report Federal Transit Administration. December, 2006. Pg. 78

[4] Report on Injuries in America. "Selected Measures of Unintentional Injuries, U.S., 2001-2005" (National Safety Council, Washington, D.C.) (www.nsc.org/library/report_table_2.htm) Last Accessed: December 27, 2007

[5] Transit Safety & Security Statistics & Analysis 2003 Annual Report Federal Transit Administration. December, 2006. Pg. 80

Table 1 reveals that transit modes have significantly lower crash, fatality, and injury rates than traveling by private vehicle. This suggests that there could be some significant safety benefits in shifting some travel from private vehicle to transit modes. A recent report commissioned by the Automobile Association of America, estimates that the average cost, in 2005 dollars, of a fatality is $3,246,192 and the average cost of an injury is $68,170.[6]

As part of the request analysis of cost and benefits of regional transit, the TPB staff will attempt to quantify a range of the potential safety benefits to the region as a result of modal shifts due to a regional transit system.

Methodology

The Atlanta Regional Commission staff has undertaken an effort to model the Concept 3 vision for regional transit developed by the Transit Planning Board. A base model update only changes the transit network for the year 2030. All population, employment, and roadway networks remain the same as the adopted 2030 Envision6 model to allow a direct comparison of changes to travel behavior as a result solely of transit infrastructure improvements. To provide a range of the potential benefits from safety improvements, two approaches were used. One approach was similar to the ARC E6 approach in examining the reduction of total crashes that might be expected. The other approach examined only the potential reduction in fatalties and injuries from the modal shift to transit. The basic approach for each method was the same.

First, estimate the total number of annual passenger miles for each transit mode. The model outputs yield a daily weekday trip number by mode. Equation 1 was used to estimate annual ridership:

Equation 1: $AR_i = Weekday\ Unlinked\ Trips_i * (WK + 1/2Sat + 1/3Sun)$

where:
i = Mode
AR = Annual Ridership Estimate
WK = Number of day with Weekday Service in a normal year
Sat = Number of days with Saturday Service in a normal year[7]
Sun = Number of Days with Sunday service in a normal year[8]

Equation 2 was used to estimate annual passenger miles

Equation 2: $PM_i = AR_i * AvgTripLength_i$

where:

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[6] Cambridge Systematics, Inc and Michael D. Meyer, Crashes vs. Congestion – What's the Cost to Society (Bethseda, MD, March 5, 2008).

[7] Saturday service days are assumed to be all regular Saturdays in an average year (52), plus additional days normally scheduled with Saturday service such as the day of Thanksgiving and Christmas Eve day or 54 days per year

[8] Sunday service days are assumed to be all regular Sundays in an average year (52), plus Thanksgiving, the Fourth of July, Memorial Day, Labor Day, and Christmas, or 57 days per year

i = Mode
AR = Annual Ridership Estimate
PM = Estimated Annual Passenger Miles
AvgTripLength = Average Trip Length in miles

Table XX below presents the average trip length by mode. Commuter rail and express bus trips were estimated at the same lengths because of their similarities of trip type. For the same reason, LRT, Premium BRT, and HRT trip lengths were assumed to be the same length. Streetcar, Beltline, and Local Bus trips were also considered to be the same average length because of their similar nature as well.

Mode	Average Trip Length (miles)
HRT[9]	7.08
LRT	7.08
Streetcar / Beltline	4.03
Premium BRT	7.08
Express Bus[10]	26.8
Local Bus[11]	4.03
Commuter Rail	26.8

Table 2 – Average Trip Length by Mode for Estimation Purposes

To estimate the number of potential crashes, fatalities, or injuries by mode using the rates from table 2, the Equation 3 was used:

Equation 3: $CT_{ij} = PM_i * CR_j$

where:
i = Mode
j = Crash type (crash only, injury or fatality)
PM = Estimated Annual Passenger Mikes
CR = Crash rate / 100,000,000 passenger miles
CT = Total number of crashes for mode and type

Since the crash rates are specific to each tavel mode, total crashes / fatalities or injuries from transit travel were estimated by summing the modal specific results using Equation 4:

Equation 4: $TTCj = \sum CT_{ij}$

where:
i = Mode

[9] Source: MARTA 2006 NTD Report: Annual Passenger Miles HRT / Annual Passenger Trips
[10] Source: GRTA Presentation to the TPB Board, May 24, 2007
[11] Source: NTD 2006, Average Atlanta Regional Bus Trip Lenth

j = Crash type (crash only, injury or fatality)
CT = Total number of crashes for mode and type
TTC = Total for of crashes all modes

In order to compare the difference between estimate crashes, fatalities, or injuries resulting from a modal shift to transit, it was necessary to estimate the number of crashes, fatalities, or injuries that would occurred had these trips taken place via another mode. Several assumptions to estimate vehicle miles need to be stated. First, since the model choice split in the ARC model takes place after the trip assignment process, it was assumed that trips that utilize one of the transit modes would take place regardless of what mode they utilized. Second, since the shortest average trip length by mode used to estimated transit passenger miles was 4.03 miles, each of these trips would take place using a motorized mode. Third, each of the replaced transit trips would be replaced with a trip in a private auto, either SOV, HOV2, HOV3+, etc. Therefore, all passenger miles taken by transit trips could be estimated as taking place in private vehicles if there was no transit system. Therefore, estimated crashes, injuries or fatalities if all transit trips were shifted to the private auto were calculated with the Equations 5 and 6:

Equation 5: $EVM = (\sum PM_i) * VO$

where:
EVM = Estimated vehicle miles traveled
PM = Estimated annual passenger Miles
VO = Vehilce Occupancy Rate
i = Mode

Equation 6: $TC_{auto\,j} = EVM * CR_j$

where:
j = Crash type (crash only, injury or fatality)
EVM = Estimated Annual Vehicle Miles
CR = Crash rate / 100,000,000 vehicle miles
TC = Estimated number of crashes if trips switched to auto

In order to estimate the number of avoided crashes, fatalities, or injuries, the Equation 7 was used:

Equation 7: $AC_j = TC_{auto\,j} - TTC_j$

where:
AC_j = Estimated avoided crashes
TC_{auto} = Estimated number of crashes if trips switch to auto
TTC = Total estimated number of transit crashes

Finally, the Equation 8 was used to estimate the value of avoided crashes, fatalities, or injuries:

Equation 8: $Value = AC_j * V_j$

where:
AC_j = Estimated avoided crashes
Vj= Estimated value of crash, fatality or injury
Value = Estimated value of all avoided crashes, fatalities, or injuries by mode shift to transit

As mentioned before, the report from the Automobile Association of America, estimates that the average cost, in 2005 dollars, of a fatality is $3,246,192 and the average cost of an injury is $68,170.[12]

[12] Cambridge Systematics, Inc and Michael D. Meyer, Crashes vs. Congestion – What's the Cost to Society (Bethseda, MD, March 5, 2008).